Amendment to the Claims

1. (Original) An ampoule for producing a reaction gas for processing a microfeature workpiece in a reaction chamber, the ampoule comprising:

a vessel including an interior volume having a precursor region configured to receive a precursor and a headspace above the precursor region;

a conduit in the vessel, the conduit having a first portion in the precursor region, a second portion in the headspace, an opening in the first portion positioned to be in the precursor, and an outlet in the second portion positioned to be in the headspace; and

a flow driver for flowing precursor through the conduit and into the headspace to increase the surface area of the precursor exposed to a carrier gas.

2. (Original) The ampoule of claim 1 wherein:

the conduit comprises a lift tube having the opening and the outlet; and

the flow driver comprises a carrier gas conduit positioned relative to the lift tube to flow carrier gas into the lift tube via the opening and entrain precursor in the carrier gas.

3. (Withdrawn) The ampoule of claim 1 wherein:

the conduit comprises a lift tube having the opening and the outlet; and

the flow driver comprises a pump configured to flow precursor through the lift tube.

4. (Original) The ampoule of claim 1, further comprising a precursor exposure assembly at least partially within the headspace and positioned so that at least some of the nonvaporized precursor flows from the conduit onto the precursor exposure assembly to increase the surface area of the precursor exposed to the carrier gas.

5. (Original) The ampoule of claim 1, further comprising a precursor exposure assembly at least partially within the headspace, the precursor exposure assembly including a plurality of trays configured in a stack and positioned so that at least some of the nonvaporized

precursor flows from the conduit into at least one of the trays to increase the surface area of the precursor exposed to the carrier gas.

6. (Original) The ampoule of claim 1, further comprising a precursor exposure assembly at least partially within the headspace, the precursor exposure assembly including a plurality of trays configured in a stack and positioned so that at least some of the nonvaporized precursor flows from the conduit into a tray at the top of the stack, the trays having at least approximately the same cross-sectional dimension and a plurality of notches so that precursor flows downward from one tray to an adjacent tray, the trays being configured to carry discrete volumes of precursor to increase the surface area of the precursor exposed to the carrier gas.

7. (Withdrawn) The ampoule of claim 1, further comprising a precursor exposure assembly at least partially within the headspace, the precursor exposure assembly including a plurality of channels positioned so that at least some of the nonvaporized precursor flows from the conduit into the channels to increase the surface area of the precursor exposed to the carrier gas.

8. (Withdrawn) The ampoule of claim 1, further comprising a precursor exposure assembly at least partially within the headspace, the precursor exposure assembly including a conical surface positioned so that at least some of the nonvaporized precursor flows from the conduit onto the conical surface to increase the surface area of the precursor exposed to the carrier gas.

9. (Original) An ampoule for producing a reaction gas for processing a microfeature workpiece in a reaction chamber, the ampoule comprising:

a vessel including an interior volume configured to receive a precursor with a headspace above the precursor; and

a carrier gas conduit for conveying a flow of carrier gas in the vessel, the carrier gas conduit having an outlet positioned to be in the headspace and an opening positioned to be in the precursor so that the carrier gas entrains precursor as the carrier gas flows through the conduit.

10. (Original) The ampoule of claim 9, further comprising a precursor exposure assembly at least partially within the headspace and positioned so that at least some of the nonvaporized precursor flows from the carrier gas conduit onto the precursor exposure assembly to increase the surface area of the precursor exposed to the carrier gas.

11. (Original) The ampoule of claim 9, further comprising a precursor exposure assembly at least partially within the headspace, the precursor exposure assembly including a plurality of trays configured in a stack and positioned so that at least some of the nonvaporized precursor flows from the carrier gas conduit into at least one of the trays to increase the surface area of the precursor exposed to the carrier gas.

12. (Withdrawn) The ampoule of claim 9, further comprising a precursor exposure assembly at least partially within the headspace, the precursor exposure assembly including a plurality of channels positioned so that at least some of the nonvaporized precursor flows from the carrier gas conduit into the channels to increase the surface area of the precursor exposed to the carrier gas.

13. (Withdrawn) The ampoule of claim 9, further comprising a precursor exposure assembly at least partially within the headspace, the precursor exposure assembly including a conical surface positioned so that at least some of the nonvaporized precursor flows from the carrier gas conduit onto the conical surface to increase the surface area of the precursor exposed to the carrier gas.

14. (Original) An ampoule for producing a reaction gas for processing a microfeature workpiece in a reaction chamber, the ampoule comprising:

a vessel including an interior volume configured to receive a precursor with a headspace above the precursor;

a first conduit having an opening positioned to be in the precursor and an outlet positioned to be in the headspace; and

a carrier gas conduit for conveying a flow of carrier gas in the vessel, the carrier gas conduit having an outlet positioned relative to the first conduit to flow the carrier gas into the first conduit via the opening and entrain precursor in the carrier gas.

15. (Original) The ampoule of claim 14, further comprising a precursor exposure assembly at least partially within the headspace and positioned so that at least some of the nonvaporized precursor flows from the first conduit onto the precursor exposure assembly to increase the surface area of the precursor exposed to the carrier gas.

16. (Original) The ampoule of claim 14, further comprising a precursor exposure assembly at least partially within the headspace, the precursor exposure assembly including a plurality of trays configured in a stack and positioned so that at least some of the nonvaporized precursor flows from the first conduit into at least one of the trays to increase the surface area of the precursor exposed to the carrier gas.

17. (Withdrawn) The ampoule of claim 14, further comprising a precursor exposure assembly at least partially within the headspace, the precursor exposure assembly including a plurality of channels positioned so that at least some of the nonvaporized precursor flows from the first conduit into the channels to increase the surface area of the precursor exposed to the carrier gas.

18. (Withdrawn) The ampoule of claim 14, further comprising a precursor exposure assembly at least partially within the headspace, the precursor exposure assembly including a conical surface positioned so that at least some of the nonvaporized precursor flows from the first conduit onto the conical surface to increase the surface area of the precursor exposed to the carrier gas.

19. (Original) An ampoule for producing a reaction gas for processing a microfeature workpiece in a reaction chamber, the ampoule comprising:

a vessel including an interior volume configured to receive a precursor with a headspace above the precursor;

a conduit for conveying a flow of precursor to the headspace;

a carrier gas inlet for flowing carrier gas into the vessel; and

a precursor exposure assembly at least partially within the headspace and positioned so that at least some of the nonvaporized precursor flows from the conduit onto the precursor exposure assembly to increase the surface area of the precursor exposed to the carrier gas.

20. (Original) The ampoule of claim 19 wherein:

the conduit comprises a lift tube having an opening positioned to be in the precursor and an outlet positioned to be in the headspace; and

the ampoule further comprises a carrier gas conduit coupled to the carrier gas inlet and the lift tube, the carrier gas conduit configured to convey a flow of carrier gas into the lift tube and entrain precursor in the carrier gas.

21. (Original) The ampoule of claim 19 wherein:

the conduit comprises a lift tube having an opening positioned to be in the precursor and an outlet positioned to be in the headspace; and

the ampoule further comprises a carrier gas conduit coupled to the carrier gas inlet and having an outlet positioned relative to the lift tube to flow carrier gas into the lift tube via the opening and entrain precursor in the carrier gas.

22. (Withdrawn) The ampoule of claim 19 wherein:

the conduit comprises an opening positioned to be in the precursor and an outlet positioned to be in the headspace; and

the ampoule further comprises a pump configured to flow precursor through the conduit.

23. (Original) The ampoule of claim 19 wherein the precursor exposure assembly includes a plurality of trays configured in a stack and positioned so that at least some of the nonvaporized precursor flows from the conduit into at least one of the trays to increase the surface area of the precursor exposed to the carrier gas.

24. (Withdrawn) The ampoule of claim 19 wherein the precursor exposure assembly includes a plurality of channels positioned so that at least some of the nonvaporized precursor flows from the conduit into the channels to increase the surface area of the precursor exposed to the carrier gas.

25. (Withdrawn) The ampoule of claim 19 wherein the precursor exposure assembly includes a conical surface positioned so that at least some of the nonvaporized precursor flows from the conduit onto the conical surface to increase the surface area of the precursor exposed to the carrier gas.

26. (Original) An ampoule for producing a reaction gas for processing a microfeature workpiece in a reaction chamber, the ampoule comprising:

a vessel including an interior volume configured to receive a precursor with a headspace above the precursor;

a conduit in the vessel, the conduit having an opening positioned to be in the precursor and an outlet positioned to be in the headspace; and

a means for flowing precursor through the conduit and into the headspace to increase the surface area of the precursor exposed to a carrier gas.

27. (Original) The ampoule of claim 26 wherein:

the conduit comprises a lift tube having the opening and the outlet; and

the means for flowing precursor comprises a carrier gas conduit positioned relative to the lift tube to flow carrier gas into the lift tube via the opening and entrain precursor in the carrier gas.

28. (Withdrawn) The ampoule of claim 26 wherein:

the conduit comprises a lift tube having the opening and the outlet; and

the means for flowing precursor comprises a pump configured to flow precursor through the lift tube.

29. (Original) An ampoule for producing a reaction gas for processing a microfeature workpiece in a reaction chamber, the ampoule comprising:

a vessel including an interior volume configured to receive a precursor with a headspace above the precursor;

a conduit for conveying a flow of precursor into the headspace; and

a flow driver for flowing precursor through the conduit and into the headspace to increase the surface area of the precursor exposed to a carrier gas.

30. (Original) The ampoule of claim 29 wherein:

the conduit comprises an opening positioned to be in the precursor and an outlet positioned to be in the headspace; and

the flow driver comprises a carrier gas conduit positioned relative to the conduit to flow carrier gas into the conduit via the opening and entrain precursor in the carrier gas.

31. (Withdrawn) The ampoule of claim 29 wherein:

the conduit comprises an opening positioned to be in the precursor and an outlet positioned to be in the headspace; and

the flow driver comprises a pump configured to flow precursor through the conduit.

32. (Original) A system for depositing materials onto a microfeature workpiece in a reaction chamber, the system comprising:

a vessel including an interior volume configured to receive a precursor with a headspace above the precursor;

a carrier gas conduit for conveying a flow of carrier gas in the vessel, the carrier gas conduit having an outlet positioned to be in the headspace and an opening positioned to be in the precursor so that the carrier gas entrains precursor as the carrier gas flows through the conduit;

a gas delivery line in fluid communication with the headspace; and

a gas phase reaction chamber coupled to the gas delivery line.

33. (Original) The system of claim 32, further comprising a precursor exposure assembly at least partially within the headspace and positioned so that at least some of the nonvaporized precursor flows from the carrier gas conduit onto the precursor exposure assembly to increase the surface area of the precursor exposed to the carrier gas.

34. (Original) The system of claim 32, further comprising a precursor exposure assembly at least partially within the headspace, the precursor exposure assembly including a plurality of trays configured in a stack and positioned so that at least some of the nonvaporized precursor flows from the carrier gas conduit into at least one of the trays to increase the surface area of the precursor exposed to the carrier gas.

35. (Withdrawn) The system of claim 32, further comprising a precursor exposure assembly at least partially within the headspace, the precursor exposure assembly including a plurality of channels positioned so that at least some of the nonvaporized precursor flows from the carrier gas conduit into the channels to increase the surface area of the precursor exposed to the carrier gas.

36. (Withdrawn) The system of claim 32, further comprising a precursor exposure assembly at least partially within the headspace, the precursor exposure assembly including a conical surface positioned so that at least some of the nonvaporized precursor flows from the carrier gas conduit onto the conical surface to increase the surface area of the precursor exposed to the carrier gas.

37. (Original) A system for depositing materials onto a microfeature workpiece in a reaction chamber, the system comprising:

a vessel including an interior volume configured to receive a precursor with a headspace above the precursor;

a carrier gas line for providing carrier gas to the vessel;

a conduit having an opening positioned to be in the precursor and an outlet positioned to be in the headspace;

a flow driver for flowing precursor through the conduit and into the headspace to increase the surface area of the precursor exposed to the carrier gas;

a gas delivery line in fluid communication with the headspace; and

a gas phase reaction chamber coupled to the gas delivery line.

38. (Original) The system of claim 37 wherein:

the conduit comprises a lift tube having the opening and the outlet; and

the flow driver comprises a carrier gas conduit coupled to the carrier gas line and the lift tube, the carrier gas conduit configured to convey a flow of carrier gas into the lift tube and entrain precursor in the carrier gas.

39. (Original) The system of claim 37 wherein:

the conduit comprises a lift tube having the opening and the outlet; and

the flow driver comprises a carrier gas conduit coupled to the carrier gas line and having an outlet positioned relative to the lift tube to flow carrier gas into the lift tube via the opening and entrain precursor in the carrier gas.

40. (Withdrawn) The system of claim 37 wherein:

the conduit comprises a lift tube having the opening and the outlet; and

the flow driver comprises a pump configured to flow precursor through the lift tube.

41. (Original) The system of claim 37, further comprising a precursor exposure assembly at least partially within the headspace and positioned so that at least some of the nonvaporized precursor flows from the conduit onto the precursor exposure assembly to increase the surface area of the precursor exposed to the carrier gas.

42. (Original) A system for depositing materials onto a microfeature workpiece in a reaction chamber, the system comprising:

a vessel including an interior volume configured to receive a precursor with a headspace above the precursor;

a conduit for conveying a flow of precursor to the headspace;

a carrier gas line for providing carrier gas to the vessel;

a precursor exposure assembly at least partially within the headspace and positioned so that at least some of the nonvaporized precursor flows from the conduit onto the precursor exposure assembly to increase the surface area of the precursor exposed to the carrier gas;

a gas delivery line in fluid communication with the headspace; and

a gas phase reaction chamber coupled to the gas delivery line.

43. (Original) The system of claim 42 wherein:

the conduit comprises a lift tube having an opening positioned to be in the precursor and an outlet positioned to be in the headspace; and

the system further comprises a carrier gas conduit coupled to the carrier gas line and the lift tube, the carrier gas conduit configured to convey a flow of carrier gas into the lift tube and entrain precursor in the carrier gas.

44. (Original) The system of claim 42 wherein the precursor exposure assembly includes a plurality of trays configured in a stack and positioned so that at least some of the nonvaporized precursor flows from the conduit into at least one of the trays to increase the surface area of the precursor exposed to the carrier gas.

45. (Withdrawn) The system of claim 42 wherein the precursor exposure assembly includes a plurality of channels positioned so that at least some of the nonvaporized precursor flows from the conduit into the channels to increase the surface area of the precursor exposed to the carrier gas.

46. (Withdrawn) The system of claim 42 wherein the precursor exposure assembly includes a conical surface positioned so that at least some of the nonvaporized precursor flows from the conduit onto the conical surface to increase the surface area of the precursor exposed to the carrier gas.

47-66. (Canceled)